THE GLACIAL EPOCH.

By ALBERT B. REAGAN.

DISCUSSION OF THEORIES OF SCIENTISTS REGARDING THIS INTERESTING PERIOD OF THE WORLD'S HISTORY—THE AUTHOR PRESENTS A NEW THEORY—WHAT ARE THE CRITICAL PERIODS OF THE EARTH'S HISTORY, AND WHY DO THEY OCCUR?

OF ALL SUBJECTS in geology, with probably the exception of the subject of evolution, the glacial epoch is the most interesting, the most discussed, and one of the least understood.

The questions: Why did the earth's climate change from the universal tropical Tertiary to the frigid ice-drift climate? Why did the animals, without respect to kind, seek shelter, at the beginning of said epoch, in caves and in every conceivable place, where they were overcome, as their fossil remains indicate? Why did the then large tropical species allow the ice drift to overtake them, instead of moving towards the equator as it advanced? and What force lifted the water into the air, which, when condensed, constitued those world-cloaks of frozen water? are still in conjecture.

Many theories, it is true, have been advanced to explain the causes of the glacial climate of said epoch; but a mere glance at them will show that they all have objectionable points, the deluge theory as the cause of the drift having already lost credence.

The theory advanced by many geologists and scientists, that the change of climate was caused by the combined influence of northern elevation in high latitudes, which elevation caused a broad connection of North America and Europe in the higher regions; of the sinking of the Central American lands, thus changing the Gulf Stream from its present course into the Pacific ocean, therefore depriving the North Atlantic of the Gulf Stream's warming influence, and also of the tendency of cold to perpetuate itself by ice accumulation, like the theories that will be mentioned later, has many objectionable phases. In the first place, the above-mentioned cause would not produce an ice sheet one mile in thickness as far south as the city of Des Moines, Iowa, which city is situated in the glaciated region,

because even now the non-ocean-current-influenced plateau of eastern Turkestan, nearly one-half of which country is north of that city, has an altitude of more than two miles greater than that of the above-mentioned city of Des Moines (Swinton's Geography, p. 110); yet, though cold, it is not covered by an ice sheet one mile in thickness, 6000 feet being the supposed thickness of the ice sheet in the New England and North Central States (Le Conte's Elements of Geology, p. 576), nor by any ice sheet at all in the summer. And furthermore, the plateaus of the Desert of Gobi and Mongolia, which are situated, for the most part, wholly north of said city, and whose altitudes are more than one and one-half miles greater than that city's altitude, are not covered by perpetual ice, though the balmy and moisture-carrying breezes from the Pacific ocean are shut out by the Khingan mountains. Not only that, but there are places in interior Asia, on the same latitude as St. Petersburg, that are over 2000 feet—the supposed elevation of glacial times (Le Conte)—higher than that city, yet perpetual snow does not rest upon them. Another serious objection to the elevation theory is, that now we are having northern elevation of land and southern depression of the same. Nevertheless, the antarctic ice sheet is at present larger and thicker than the now existing ice cap in the northern hemisphere. (Le Conte's Elements of Geology, p. 613.) Still another serious objection is that, had the arctic plains been elevated and afterwards depressed, as the theory suggests, they would have faulted as has the basin region; but no such faults are to be found. Geological causes alone, therefore, are quite insufficient to explain the causes of the frigid climate of the glacial epoch. To use the words of Mr. T. J. Bonney, "Each attempt to account for the glacial epoch solely by terrestrial causes places us on the horns of some dilemma." (Story of Our Earth, p. 495.)

To meet the objections to the above theory, Mr. Croll has advanced the theory that the glacial epoch was caused by the combined influence of the precession of the equinoxes and the secular changes in the eccentricity of the earth's orbit. (See Lyell's Principles of Geology, vol. I, p. 275.)

This condition, says this accepted authority on the subject, would make the northern winter twenty-two days longer and

20° colder than now, and the summers twenty-two days shorter and much hotter. (See Le Conte's Elements, p. 614.)

As a first objection, the winter temperature at Des Moines, Iowa, which city, as is stated above, was in the glaciated region, is about 16° above zero, and the summer average is 77°. Now the winter average in glacial times, according to the above theory, was 4° below zero and the summer average much hotter than now. This would not give a glacial climate at that city, for even now the average yearly temperature for St. Petersburg is much lower than that of the site of the city of Des Moines in glacial times, to use the above figures. Notwithstanding that, St. Petersburg does not enjoy perpetual winter. This theory does not also account for the long continuation of the glacial epoch, which is supposed to have lasted 160,000 years (see Le Conte's Elements of Geology, p. 617), because within this period the equinoxes would have made more than seven complete precessions, 26,000 years being a precession (Lyell's Principles of Geology, vol. I, p. 275), and would therefore have been in complete opposition to a glacial climate more than seven times during the epoch.

To meet the many objections in Croll's theory, Mr. Wallace combines all the above-mentioned theories in one and says that the glacial epoch was due to the combined influence of aphelion winter, maximum eccentricity of the earth's orbit, and northern elevation. (See Le Conte's Elements of Geology, p. 616.) To this theory there are many objections. Croll says that the highest-latitude northern regions were not elevated in that epoch, but were lower then than now, the elevation theory only being used as a hypothesis to account for the cold. (Climate and Time, p. 391.)

H. B. Norton also agrees with Mr. Croll in believing that northern elevation of land did not then exist. His remarks on the subject are as follows:

"When we come to study the cause of these phenomena (the phenomena of the ice age) we find many perplexing and contradictory theories in the field. A favorite one is that of vertical elevation. But it seems impossible to admit that the circle inclosed within the parallel of 40°—some 7000 miles in diameter—could have been elevated to such a height as to produce this remarkable result. This would be a supposition hard to reconcile with the present proportion of land and water on the surface of the globe and with the phenomena of

terrestrial contraction and gravitation." (Popular Science Monthly, October, 1879, p. 833.)

On the same subject Geikie says:

"It has been demonstrated that the protuberance of the earth at the equator so vastly exceeds that of any possible elevation of mountain masses between the equator and the poles that any slight changes which may have resulted from such geological causes could have only an infinitesimal effect upon the general climate of the globe." (The Great Ice Age, p. 98.)

We must, therefore, fall back to Croll's theory, which Mr. Wallace and many other scientists and geologists say was not sufficient to produce so protracted a glacial epoch as is supposed to have existed. But if Mr. Croll's theory, or even Mr. Wallace's, is accepted it is simply because no better one has been advanced, for it does not account for a contemporaneous southern ice sheet which, as is proved below, did then exist.

As evidence of contemporaneous glacial action, Le Conte says that the glacial action in the glacial epoch was as extensive in the southern hemisphere as in the northern. (Elements of Geology, p. 596.)

In reference to the same, Dana says:

"In South America in glacial times, indications of great ice masses are met with from Fugia as far toward the equator as 37°, and especially, as Agassiz has shown, in the great valley between the Andes and the coast mountains to the latitude of Conception."

He also states on the same page that there were glaciers in that epoch in New Zealand, and also in Australia and Tasmania. (Manual of Geology, 4th ed., p. 977.)

Now, since the above-mentioned men are recognized authority on this subject, it is evident, beyond the least shadow of a doubt, that the glacial epoch was not caused by the combined influence of northern elevation, the precession of equinoxes, and maximum eccentricity of the earth's orbit, for as Mr. T. J. Bonney says (Story of Our Earth, p. 502), the precession of the equinoxes and aphelion winter in conjunction would produce a cold climate in one hemisphere and the direct opposite in the other, because if said aphelion winter and the precession of equinoxes in conjunction would make the winters twenty-two days longer than now in the northern hemisphere,

and the summers twenty-two days shorter than at present, as Croll's theory suggests (see above), the summer in the southern hemisphere, since in said hemisphere the seasons are the opposite of ours, would be twenty-two days longer than our present northern summer, and, no doubt, on the whole much hotter, and the winters of that epoch in said hemisphere would be twenty-two days shorter and less cold than now. It is, therefore, necessary to look for some other cause for the frigid climate of the glacial epoch—a cause that will account for the contemporaneous ice sheets, the one in the northern hemisphere and the coexisting and equally extensive one in the southern hemisphere.

To find the real cause of the climate of said epoch, it is necessary, it seems to me, to inquire, What was the glacial epoch? What epoch, in comparison with the other epochs of the earth's history, does it represent? To use the words of Professor Le Conte: "The Quaternary, of which the glacial epoch was the first part, is a critical period." (Elements of Geology, p. 619.)

This definition leads to other and more complicated questions, some of which are: What are the critical periods of the earth? and, Why do they occur?

In answer to the first question, Le Conte says (Elements of Geology, p. 619) that the critical periods of the earth's history have been periods of oscillation of the earth's crust between the great eras, periods of rest, and therefore of changes of physical geography, marked by unconformity of strata; and of changes of climate, marked by apparently abrupt changes of species, *i. e.*, periods of revolution and rapid change. Again, Le Conte says, on the page opposite to the one mentioned above, that three of the known critical periods have been periods of cold in one or the other of the hemispheres or in both, the latter being known to have occurred in the glacial epoch.

The second question, "Why do critical periods occur?" is very hard to answer and involves a cosmical cause, a cause which when once understood will explain not only the causes of the glacial epoch, but most if not all of the geological phenomena of our globe as well. As an answer to this question the author will submit the following.

In the American Encyclopedia, vol. XV, page 471, it is stated that our sun moves in space, and that it is moving from west to east at the rate of more than 150,000,000 miles per annum. And concerning the same subject Mr. Todd says that the sun is moving in space from a point midway between Sirius and Canopus toward the constellation Vega (New Astronomy, p. 431); and another astronomer says (see an astronomical article in the July number of McClure's Magazine for 1899) that though our center has been known to be moving in space since the early days of the Chaldeans, yet it is not known whither he is gong or where he is transporting his entire family of planets, satellites, and comets.

Now, since astronomers have proved that the sun moves in space it evidently, therefore, must have an orbit, because all bodies moving in space, whose courses can be traced out at the present time, have orbits, and the sun, like all other bodies in space, is composed of matter and does move, and consequently must obey some attractive law. It therefore has an orbit, but one of immense size, for Mr. Todd says (see above):

"So vast is this orbit of the sun that no deviation from a straight line is as yet ascertained, although our motion along that orbit is about twelve miles per second."

Now if the sun has an orbit, as Mr. Todd and all of our leading astronomers say it has, and which the very facts in the case indicate, it must have a central attractive center the same as all other bodies so far as known which have orbits. This attractive center, most likely, is a central sun, as was a favorite hypothesis in the middle of the nineteenth century; or, if not a central sun, it is at least a great central magnetic center, whose attractive influence controls not only our sun, with his attendants, but all matters throughout limitless space.

Just where this attractive center is located is unknown, but it is easy to conjecture with a great deal of accuracy that it is located in the northern heavens, in the vicinity of or beyond the dippers, or in the opposite heavens, because not only our earth, but all the brother planets and even the sun himself have their axis inclined toward the plane of their respective orbits toward a point in the northern heavens (American Encyclopedia, vol. XV, p. 471). Now, if this center be positive it is located in the northern sky, because the north magnetic pole of our earth is negative, but if negative it is situated in the

southern heavens, for the reason that our south magnetic pole which would be attracted by it is positive. For this discussion, however, the author will suppose that this central magnetic center is situated in the northern heavens nearly in line at present with Polaris, and around this center our sun, in conjunction with the universe, is making his grand journey.

Now, the sun's orbit is not an exact circle, but, like all the orbits that have been traced out, it is elliptical. Again, when the sun reaches the point in his orbit nearest the great center, at which point he probably is near now, for reasons which will be given hereafter, his axis together with the axis of his attendants must incline more and more as he advances from said point in order to still keep in line with said great magnetic center, as they do now; and should our system advance in space to or even beyond Vega before making the turn in his journey, it is not beyond the possible that the earth's axis will then be inclined 30 degrees to the plane of its orbit in order that its magnetic axis still be in line with said magnetic center. To this, of course, astronomers and geologists will object by saying that no such change in the inclination of the earth's axis due to said cause has been detected. As answer to the above, may it be sufficient to say, as Mr. Todd says (see above), that though the solar system has been observed to be moving in space since the early infancy of our race, yet so vast is its orbit that no deviation from a straight line has been observed it would be impossible as yet to detect any change in the inclination of the earth's axis due to said cause? Nevertheless, if the sun does move in space, the axes of our earth, the other planets and even of the sun himself must change their angles of inclination, as a simple experiment will show.

As the earth's axis becomes more and more inclined, after the sun reaches the nearest point in his orbit to the great center while he is making his grand journey toward Vega, the arctic and antarctic circles will advance toward the equator till the frigid zones will reach from 60 degrees or even less to the poles, instead of 66½ degrees as now. This greater inclination of the earth's axis will cause a greater difference of temperature between summer and winter and between the equator and the poles than now exists, which Croll says is of itself sufficient to produce a glacial epoch; but we will go a

step farther. This greater inclination will cause during winter a higher barometer than now, *i. e.*, greater atmospheric pressure over the high latitudes and a low barometer in the tropics. In addition to this, the much heavier winter snowfall will greatly increase the pressure in the high latitudes. In summer, of course, the condition of things will be reversed. It is evident, therefore, the the northern hemisphere will then be enjoying a higher pressure, while the southern will be enjoying a lower one than now, and *vice versa.* Besides this, the attractive power of the sun and also of the moon upon the higher latitude regions of the earth will vary more between summer and winter than at present. Now, Mr. Alexis Perry has shown conclusively from the comparison of a tabulated list of nearly all the earthquakes that have occurred in our history:

1. That earthquakes are a little more frequent when the moon is on the meridian than when she in on the horizon.

2. That they are a little more frequent at new and full moon than at half moon.

3. That they are a little more frequent when the moon is nearest the earth than when she is farthest away.

(See Le Conte's Elements of Geology, p. 139.) Also, Le Conte says that by an extensive comparison of this same list of earthquake occurrences with the seasons it has been shown that earthquakes are more frequent in winter than in summer. And furthermore, Professor Knott has shown (see Le Conte's Elements, p. 139) that the earthquakes of the present time are brought on for the most part by the change of excess of pressure between summer and winter and between the equator and the poles. It is conclusive, therefore, that if the present changes of pressure between summer and winter and between the poles and the tropics, and the variation of the attractive power of the moon upon the earth from full moon to full moon again, and her variation of attraction in conjunction with the sun's upon the middle latitudes and the polar regions from summer in one hemisphere to summer in the other are the main causes of the quaking of the earth's shrinking crust today, this greater change of excess of pressure and of the sun's attractive influence, and also of the moon's, from winter in one hemisphere to winter in the other, will cause the earth's crust to yield in all its weakest points, which Le Conte says is at or

near the coast line where the thickest sediment has been deposited. This thick sediment will yield to the lateral pressure and will be mashed together and upswollen into a mountain range. Not only will it be upswollen into a mounta range, but in that very act the sea bottom and land surface will be faulted and fissured, the former while yet beneath the seas. The sea water will rush in to fill the opened space. The water will come in contact with the heated rocks; steam will be instantaneously generated; explosions will follow, explosions that will rend the earth from pole to pole, the debris being hurled beyond our atmosphere, probably thousands of miles. (Read the account of the eruption of Krakatoa in the Strait of Sunda, whose erupted dust particles remained suspended in the atmosphere for over two years.) Gases destructive to life will also be generated; the air will become vitiated with said obnoxious gases and dust particles; the then existing animals will seek refuge in every conceivable place from this poisonous gaseous deluge, where they will be either overcome by it or by hunger and thirst, or by the great lava flood which will be mentioned below. Other animals will preserve their kind by migration, while still others will live in more favored parts of the earth, the gases, of course, being most destructive approximate to the disturbed districts. There will be, coincident with and continuing after the great explosions, eruptions of lava both on land and sea throughout the full length of the faulted disturbed regions; the former devastating the land surface; the latter, together with the contact rock heat and now greatly heated atmosphere, will evaporate much of the ocean, whose vapors, rising to higher atmospheric regions, will be wafted toward the poles, where, when the reaction sets in, they will be condensed and fall as snow. This snow will continue to fall and the temperature to decrease till the high latitudes will be covered with immense ice sheets, because, as Mr. Newton has proved, to every action there is an equal and opposite reaction. Not only that, but the change will be brought on so suddenly that many of the remaining species of the earth that have survived the fiery lava and gaseous dust storm will be overtaken by it and there perish with cold. This is the next future critical period of our earth, and also a glacial epoch, not in one hemisphere only, but in both, in which the ice sheets will be equally extensive and coexisting. Was the

glacial epoch of prehistoric times brought on by similar causes? Let us see.

At the beginning of the Tertiary age our sun was at a point in his orbit nearest the central magnetic center in his journey toward Sirius. The axis of the earth was probably inclined less than now, likely not more than twenty degrees; a perpetual summer prevailed from pole to pole. To use the words of T. J. Bonney (Story of Our Earth, p. 496): "Switzerland, and in fact all Europe, was 16 to 20 degrees warmer than at present in Eocene and Miocene Tertiary times; and Le Conte says that in the Miocene Greenland, Iceland and even Spitzbergen were covered with luxuriant temperate vegetation.

Another writer says: "This, the Tertiary period indeed for America, was the golden age of animals and plants. . . . The country was more interesting and picturesque than now. . . . This state of things, doubtless, continued throughout many thousands of years." (Popular Science Monthly, October, 1878, p. 648.)

A more recent writer says: "The middle era of this age—the Miocene Tertiary—was characterized by tropical plants, a varied and imposing fauna, and a genial climate, so extended as to nourish forests of beeches, maples, walnuts, poplars and magnolias in Greenland and Spitzbergen, while an exotic vegetation hid the exuberant valleys of England." (American Antiquarian, July, 1881, p. 280.)

On the same subject Dr. Dawson says: "This delightful climate was not confined to the present temperate or tropical regions. It extended to the very shores of the Arctic sea. In North Greenland, at Atanekerdulk, in latitude 70° north, at an elevation of more than two thousand feet above the sea, were found the remains of beeches, pines, walnuts, limes, and vines. The remains of similar plants were found in Spitzbergen in latitude 78° 56′. (Earth and Man, p. 261.)

Dr. Dawson continues: "Was not the Miocene period on the whole a better age of the world than that in which we live? In some respects it was. Obviously, there was in the northern hemisphere a vast surface of land under a mild, equable climate and clothed with a rich and varied vegetation. Had we lived in the Miocene we might have sat under our own vine and fig-tree equally in Greenland and Spitzbergen and in those more southern climes to which the privilege is now restricted." (Earth and Man, p. 264.)

The earth, therefore, in the Tertiary was a fair and lovely world; it was a garden, a paradise; but this condition of things could not last forever. As the Tertiary began to wane a change came over the fair face of nature, more terrible than we have language to describe. The sun was nearing Sirius in his western journey, the earth's axis had become inclined to probably thirty degrees, an ice-cap had begun to form, the great difference in temperature between summer and winter and between the equator and the frigid zones, the great change of atmospheric pressure from summer to winter and from the tropics to the poles, and, furthermore, the great difference of the sun's attraction and also of the moon's on the higher latitudes between summer and winter, caused a tremendous strain upon the earth's crust, a strain that the earth's crust could not withstand; and as a consequence, it yielded in all its weakest points. This event ushered in the Pliocene Tertiary.

To use the words of Professor Le Conte (Elements of Geology, p. 567): "At the end of the Miocene, *i. e.*, the beginning of the Pliocene, there occurred the greatest event of the Tertiary period, one of the greatest in the history of the American continent. At that time the sea bottom off the then Pacific coast was crushed together into the most complicated folds and upswollen into the coast chain, and at the same time the fissures were formed in the Cascade range, with the outpouring of the great lava sheet of the northwest, covering 150,000 square miles with a lava sheet from three thousand to four thousand feet in thickness. Coincidently with this there was a settling down of the basin region and the plains. Then after a short lapse of time, speaking geologically, there was a general upheaval of the continent. Coincident with this general uplift, mountain-making by crust-block tilting occurred on a grand scale. The Sierra, the Wasatch, and the Basin ranges assumed their present form and height; and the great north-and-south fault cliffs of the plateau region were formed. At the same time there were great disturbances in the Old World. The Himalayas were raised above the sea; the great Deccan lava flow, covering 200,000 square miles with a lava sheet 6000 feet thick, occurred; Europe assumed its present form; Asia added much of her southern lands; and large parts of the African continent were raised above the sea; the Pacific ocean continent went down, and most likely the

Lost Atlantis also. The gases generated by volcanic action proved fatal to life. (Consider the destructive sulphurous gases generated by Vesuvius in one of her eruptive periods, or of Mount Pelee, for example, and then remember that an eruptive period of Vesuvius or of Mount Pelee represents only in miniature the great volcanic fissure eruptions of Pliocene Tertiary and glacial Quarternary times. It is no more, in comparison with the eruptions of that period, than a single atom in comparison with the volume of the whole earth.) The animals sought shelter in caves and grottoes and in whatever place protection could be found from the hot-ashy-dust-gaseous invader, and there huddled together they perished, and their remains are known to-day as the lime-cavern fossils. In this terrible catastrophe there perished in America the horse, bos, mastodon, camel, elephant, and many of the other then tropical and temperate species which roamed over her plains. In addition to this, many of the animals that had escaped the gaseous storm were overtaken by the lava flood which followed. A few species, however, migrated to more favorable parts of the earth and in this way preserved their kind. Coincident with the lava eruptions on land there occurred greater eruptions and disturbances at sea, because the crust mashing was inaugurated beneath the sea; and the sea water was heated by coming in contact with the heated rocks and incandescent lava and the now heated atmosphere, the temperature of which had been raised by coming in contact with the molten lava hurled out on the land surface. The seas were, at least a great deal of them, evaporated. (Mr. Thomas Belt, in the Quarterly Journal of Science, says that the formation of the ice sheets at the poles in the glacial epoch must have lowered the level of the oceans of the world at least two thousand feet.) The vapors thus formed, having been wafted on high, so to speak, were carried toward the poles, where, on being cooled, they were condensed and fell as snow. Also the volcanic dust hurled by the volcanic explosions beyond our atmosphere, and surrounding the earth as rings of dust, would take up much of the sun's heat before it could reach the solid earth, thus increasing and maintaining the cold.

This great change was as sudden as was the almost instantaneous earth-crust disturbances and lava eruption, which was the immediate cause of the excessive evaporation. So sudden,

indeed, was it that the cold wave overtook many of the living tropical and temperate species of the earth, and their remains are to-day found frozen in the northern ice, where they are often found heaped up in such quantities, at places in which they huddled together for protection from the icy invader, that Admiral Wrangle tells us that in certain parts of Siberia he and his men climbed over ridges and mounds composed entirely of their bones. (Agassiz, Geological Sketches, p. 209.)

That the coming of the cold wave was sudden, and that the animals were slaughtered outright by it, is attested by more than one scientific author. On this subject Louis Figuier says: "The northern and central parts of Europe, the vast countries which extend from Scandinavia to the Mediterranean and Danube, were visited by a period of sudden and severe cold; the temperature of the polar regions seized them. The plains of Europe, but now [Miocene Tertiary] ornamented by the luxurious vegetation developed by the heat of a burning climate; the boundless pastures, on which herds of great elephants, the active horse, the robust hippopotamus and the great carnivorous animals grazed and roamed, became almost instantly covered with a mantle of ice and snow." (The World Before the Deluge, p. 435.)

Figuier continues: "We can not doubt, after such testimony, of the existence in the frozen North of the almost entire remains of the mammoth. The animals seem to have perished, suddenly enveloped in ice at the moment of their death; their bodies have been preserved from decomposition by the continual action of cold." (The World Before the Deluge, p. 496.)

And again Cuvier says: "If they [the animals] had not been frozen as soon as killed, putrefaction would have decomposed them; and, on the other hand, this eternal frost could not have previously prevailed in the place where they died, for they could not have lived in such a temperature. It was, therefore, at the same instant when these animals perished that the country they inhabited was rendered glacial. These events must have been sudden, instantaneous, and without any gradation." (Ossements, Fossils; Discourse sur les Revolutions de Globe.)

The above-mentioned snow continued to fall for ages, till an ice sheet of immense thickness was formed, not at one pole, but at both. This is the glacial epoch.

The sun, with his attendants, had passed the turning point of his orbit near Sirius, and was now advancing toward Vega; and notwithstanding the tendency of cold to perpetuate itself by ice accumulation, the ice sheets had begun to recede, and would have continued to do so in both hemispheres if aphelion winter and maximum eccentricity had not intervened and caused the northern ice sheets to advance again; but their combined influence, together with the still great inclination of the earth's axis, could not make it advance as far south as it formerly had been; and when the eccentricity of the earth's orbit begun to wane from its maximum point the ice sheets again receded and inaugurated the Champlain flood epoch, which, after it had filled the bays and gulfs up to their former level, sedimented up the river troughs cut during the time that the oceans were lowered by evaporation. (Notice here the difference: Instead of the lands being elevated during the glacial epoch, the seas were lowered by evaporation.)

Since the ushering in of the Champlain epoch the ice sheets have been gradually receding, and will continue to recede as the sun advances toward the nearest point in his orbit to this central magnetic center, till they may disappear altogether, and a paradise on earth be established similar to the one that existed in Miocene Tertiary times, though it is conclusive that the climate will be less hot than in that period, because our sun is a waning star.